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**PATENT APPLICATION
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**METHODS AND APPARATUS FOR
DISPENSING MEDIA SHEETS FROM A MEDIA STACK**

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METHODS AND APPARATUS FOR DISPENSING MEDIA SHEETS FROM A MEDIA STACK

BACKGROUND

Apparatus and methods for automatically dispensing imaging media (such as paper and the like) are known in the art. Such automatic imaging media dispensing apparatus and methods are commonly employed in conjunction with various types of media processing devices. Such media processing devices include imaging devices such as printers, scanners, photocopiers, facsimile machines, and the like.

10 Conventional media dispensing apparatus typically include at least a media
11 support device and a media picking device. The support device is generally configured
12 to support a stack of media sheets while individual sheets are picked, or dispensed, from
13 the stack. One example of a support device is known as a "paper tray." The picking
14 device is generally configured to successively dispense single media sheets from the
15 media stack. The picking device and the support device of a given media dispensing
16 apparatus are generally configured to operate in conjunction with one another and can
17 also be integral with one another.

18 Printers, as well as other forms of apparatus which employ media dispensing
19 apparatus, generally also include a media path. The media path is generally defined by
20 a series of drive rollers, guides, and the like, that are configured to operate so as to
21 move individual sheets of media along the media path. The media path is configured to
22 convey one or more successive media sheets from the picking device and through any
23 of a number of various types of processing apparatus.

24 In a typical electrophotographic printer, such processing apparatus can include,
25 for example, an image-forming apparatus as well as a fusing apparatus. A typical
26 image-forming apparatus is generally configured to form an image from an imaging
27 substance, such as toner or the like, and to deposit the toner onto a media sheet. A
28 typical fusing apparatus is generally configured to affix, or bond, respective images to
29 the media sheets by way of applying heat energy thereto. Another type of processing
30 apparatus typically employed in conjunction with a media path and a media dispensing
31 apparatus is a scanning apparatus, such as in the case of a photocopier.

32 At least in some instances, such as in the case of printers, it is desirable to
33 provide the printer controller, or processor, with data indicative of the status of the media
34 supply. That is, it is often desirable for the printer "brain" to know how many media
35 sheets remain in the media stack at any given time. Such data can be useful, for

1 example, in accurately predicting whether a certain print job can be completed before
2 the media stack is totally depleted. Generally, a relatively high degree of accuracy is
3 desired in estimating the status of the media supply.

4 Known methods of estimating the status of the media supply include the use of
5 relatively sophisticated measuring devices that are configured to measure the number of
6 media sheets remaining in the stack at a given point in time in a relatively accurate
7 manner. However, several detriments can be associated with the employment of such
8 known methods, which include reliability issues as well as initial expense, complexity,
9 and maintenance costs.

10 Therefore, it can be desirable to provide a means of estimating the supply status
11 of a stack of media to be dispensed in a media processing device, wherein such means
12 achieve the benefits to be derived from similar prior art apparatus and methods, but
13 which avoid the shortcomings and detriments individually associated therewith.

14

15 SUMMARY

16 In accordance with various embodiments of the present invention, methods and
17 apparatus for dispensing media sheets from a media stack are disclosed. An apparatus
18 in accordance with one embodiment of the present invention includes a means for
19 supporting a stack of media sheets while individual media sheets are dispensed
20 therefrom. Also included are means for dispensing the media sheets from the stack as
21 well as means for generating count data indicative of how many media sheets are
22 dispensed from the stack during a given period of time. A means for generating
23 measurement data is also included in the apparatus, wherein the measurement data is
24 indicative of a quantitative characteristic of the stack. The apparatus can also include a
25 means for computing an estimated number of media sheets remaining in the stack
26 based on the count data and the measurement data.

27 A method in accordance with one embodiment of the present invention generally
28 includes procedures and/or acts that can be employed for estimating the number of
29 media sheets remaining in the stack based on the count data and measurement data as
30 can be accomplished by the apparatus mentioned above. For example, a first
31 quantitative measurement of the stack can be obtained, and at least one sheet of media
32 can be dispensed from the stack before obtaining a second quantitative measurement of
33 the stack. A difference can be established by subtracting the second quantitative
34 measurement from the first quantitative measurement. A ratio can then be established by
35 dividing the number of media sheets dispensed between the two measurements by the

1 amount of the difference. The difference can be a difference in the weight of the stack.
2 Alternatively, the difference can be a difference in the height, or thickness, of the stack.
3 An estimated quantity of media sheets remaining in the stack can then be established by
4 multiplying the ratio by a final quantitative measurement, which can be the same as the
5 second quantitative measurement.

6

7 DESCRIPTION OF THE DRAWINGS

8 Fig. 1 is a schematic diagram in which a media dispensing apparatus is depicted
9 in accordance with one embodiment of the present invention.

10 Fig. 2 is a side elevation view in which an alternative configuration of the support
11 device and measuring device of the apparatus of Fig. 1 are depicted.

12 Fig. 3 is a side elevation view in which another alternative configuration of the
13 support device and measuring device of the apparatus of Fig. 1 are depicted.

14 Fig. 4 is a flow diagram that depicts an operational sequence that can be
15 employed to operate the apparatus shown in Fig. 1.

16 Fig. 5 is another flow diagram that depicts another operational sequence that can
17 be employed to operate the apparatus shown in Fig. 1.

18 Fig. 6 is another flow diagram that depicts yet another operational sequence that
19 can be employed to operate the apparatus shown in Fig. 1.

20

21 DETAILED DESCRIPTION

22 The present invention generally includes apparatus and methods for dispensing
23 media sheets from a stack of media sheets. Specifically, the apparatus and/or methods
24 in accordance with the various embodiments of the present invention can be employed
25 to estimate how many media sheets are left in the stack after a number of media sheets
26 are dispensed from the stack. The estimate can be established in conjunction with the
27 process of dispensing media sheets from the stack by obtaining a first quantitative
28 measurement of the stack, then dispensing a known number of media sheets from the
29 stack, and then obtaining a second quantitative measurement of the stack.

30 The quantitative measurements can be measurements of any characteristic of
31 the stack that is indicative of the relative quantity of media sheets in the stack. For
32 example, the quantitative measurement can be the weight of the stack, or it can be the
33 height, or thickness, of the stack. A ratio can then be calculated, which ratio is equal to
34 the number of media sheets dispensed divided by the change, or difference, in the two
35 quantitative measurements. The ratio can then be multiplied by a given quantitative

1 measurement to obtain the estimated number of media sheets remaining in the stack at
2 the moment the given quantitative measurement is made. The estimate of the number
3 of media sheets remaining in the stack can be useful for several purposes as is
4 explained in the discussion below.

5 Turning to Fig. 1, a schematic diagram is shown in which a media dispensing
6 apparatus 100 is depicted in accordance with one embodiment of the present invention.
7 As is seen, the apparatus 100 is generally configured to dispense individual media
8 sheets MM from a stack MS of media sheets. Once dispensed from the stack MS, the
9 individual media sheets MM can then be moved along a media path PP in the direction
10 indicated.

11 Media paths PP are known in the art. Such media paths PP can be defined by
12 any of a number of various known media sheet handling and conveyance devices such
13 as rollers, guides and the like which are not specifically depicted in the interest of clarity,
14 but which are commonly employed to move media sheets MM from one point to another.

15 As is further shown, the media path PP can be configured to convey the
16 individual media sheets MM to and/or through a processing section 200. The processing
17 section 200 can be any of a number of known devices that are configured to perform a
18 given process in conjunction with the media sheets MM. For example, the processing
19 section 200 can be an imaging device that is configured to form various predetermined
20 images from an imaging substance, such as toner or ink, and that can be further
21 configured to deposit and/or affix the images to the media sheets MM. The media
22 dispensing apparatus 100 and the processing section 200 can be integral with one
23 another. In the alternative, the media dispensing apparatus 100 and the processing
24 section 200 can be separate from one another.

25 The media dispensing apparatus 100 can include a media support device 110
26 that is adapted to support the media stack MS (a stack of media sheets MM) thereon.
27 The support device 110 is discussed in greater detail below. The apparatus 100 can
28 also include a picking device 120. The picking device 120 is configured to dispense
29 individual media sheets MM from the media stack MS ("stack") in succession. That is,
30 the picking device 120 is configured to "pull" or "draw" individual media sheets MM from
31 the stack MS in succession while leaving the remainder of the stack intact.

32 Various forms and configurations of picking devices, such as the picking device
33 120, are known in the art. The picking device 120 can include a pick roller 121. Pick
34 rollers 121 are also known in the art. As is seen, the stack MS can have a top 10 and an
35 opposite bottom 20. The bottom 20 of the stack MS can contact the support device 110

1 as the stack is supported thereon. The picking device 120, and in particular the pick
2 roller 121, can contact the top 10 of the stack MS so as to dispense individual media
3 sheets MM therefrom.

4 Generally, as can be appreciated, individual media sheets MM can be selectively
5 dispensed from the stack MS, until the stack is depleted. That is, as individual media
6 sheets MM are dispensed from the stack MS, the size of the stack becomes smaller as
7 fewer and fewer media sheets are left in the stack. Ultimately, the life of the stack MS
8 ends when either the stack is completely depleted, or additional media sheets MM are
9 added to form a new stack.

10 That is, a "stack" is defined as a stack of media sheets to which additional media
11 sheets have not been added after commencement of dispensation of media sheets from
12 the stack. In other words, the size of a stack MS for the purposes herein can only
13 diminish and cannot grow or increase. Stated yet another way, whenever media sheets
14 are added to a given stack MS, then the life of the given stack is over and a new stack is
15 formed.

16 In any case, in order to enable the picking device 120 to function, the bottom 20
17 of the stack MS can generally be moved closer and closer to the picking device as the
18 stack is depleted. That is, in order for the picking device 120 to remain in contact with
19 the top 10 of the stack MS as the stack is depleted, the bottom 20 of the stack can be
20 made to approach the picking device. Such movement of the bottom 20 of the stack MS
21 closer to the picking device 120 as the stack is depleted can be accomplished in any of a
22 number of known manners.

23 For example, the picking device 120 can be configured to move toward the
24 support device 110 as the stack MS is depleted while the support device remains
25 substantially stationary. Alternatively, the support device 110 can be configured to move
26 the bottom 20 of the stack MS toward the picking device 120 as the stack is depleted,
27 wherein the picking device remains substantially stationary. The latter case can prove
28 advantageous in that the picking device 120 does not move substantially relative to the
29 media path PP, and thus, the transition of media sheets from the top of the stack to the
30 media path is simplified.

31 Still referring to Fig. 1, the apparatus 100 can further include a measuring device
32 130. The measuring device 130 is configured to detect measurement data indicative of
33 a quantitative characteristic of the stack MS. That is, the measuring device 130 is
34 adapted to detect and measure a quantitative characteristic of the stack MS. The term
35 "quantitative characteristic" as used herein is defined as any characteristic of the stack

1 MS that can be measured and that is indicative of the relative number of media sheets
2 MM remaining in the stack.

3 For example, a quantitative characteristic of the stack MS can be the "height" or
4 "thickness" of the stack. That is, as can be appreciated, the thickness, or height, of the
5 stack MS can be measured and will decrease proportionally to the number of media
6 sheets MM remaining in the stack as the stack is depleted. As another example, a
7 quantitative characteristic of the stack MS can be the "weight" or "mass" of the stack.
8 That is, the weight, or mass, of the stack MS can also be measured and will decrease
9 proportionally to the number of media sheets MM remaining in the stack as the stack is
10 depleted.

11 Thus, the measuring device 130 can be configured to detect and measure the
12 thickness, or height, of the stack MS. Furthermore, the measuring device 130 can
13 alternatively be configured to detect the weight, or mass, of the media stack MS. It is
14 understood that the measuring device 130 is not intended to be limited to configurations
15 which are specifically shown and described herein.

16 That is, the measuring device 130 is not intended to be limited to configurations
17 in accordance with which only the thickness and/or the weight of the media stack MS
18 can be detected. In other words, it is understood that the measuring device 130 can be
19 configured, in accordance with alternative embodiments of the present invention, to
20 detect quantitative characteristics of the stack MS other than those of thickness and
21 weight.

22 Turning briefly to Figs. 2 and 3, side elevation views are shown therein in which
23 two alternative configurations of the support device 110 and measuring device 130 are
24 depicted, respectively. Specifically, first alternative configurations of a support device
25 110A and a measuring device 130A are depicted in Fig. 2. As is seen, the support
26 device 110A can include a platform 50 on which the media stack MS can be supported
27 so as to remain in contact with the pick roller 121 as the stack is depleted. As is also
28 seen, the platform 50 can be configured to pivot about a pivot point 30.

29 With further reference to Fig. 2, the support device 110A can include a lift
30 mechanism 40 that is adapted to lift the stack bottom 20 toward the pick roller 121 as the
31 stack MS is depleted. The lift mechanism 40 can be operatively connected with the
32 platform 50, wherein the lift mechanism is adapted to move the platform toward the pick
33 roller 121 as the stack MS is depleted due to dispensation of media sheets MM
34 therefrom.

1 Furthermore, the measuring device 130A can be in the form of a thickness
2 detector as shown that is configured to detect and measure the thickness of the stack
3 MS as the stack is depleted. That is, the measuring device 130A can be adapted to
4 substantially detect a position of the stack bottom 20 relative to the pick roller 121. It is
5 understood that the support device 110A and the measuring device 130A can be
6 incorporated into a single unit.

7 Moving briefly to Fig. 3, second alternative configurations of a support device
8 110B and a measuring device 130B are depicted. As is seen, the support device 110B
9 can include a platform 50 on which the media stack MS can be supported so as to
10 remain in contact with the pick roller 121 as the stack is depleted. The support device
11 110 can also include a lift mechanism 40 that is configured to move the platform 50
12 toward the pick roller 121, and thus to move the stack bottom 20 toward the pick roller.

13 Furthermore, it is seen that the measuring device 130B can be substantially in
14 the form of a weight detector such as a scale or the like. The scale can be an electronic
15 scale, configured to generate an electrical signal in response to sensing and/or detecting
16 the weight of the media stack MS. The lift mechanism 40 can be supported on the
17 measuring device 130B as is shown. Alternatively, the measuring device 130B can be
18 supported on the lift mechanism 40, wherein the platform 20 is supported directly by the
19 measuring device.

20 It is understood that the views shown in Figs. 2 and 3 are intended to provide
21 only basic principles of operation of various alternative configurations of the support
22 device 110 and the measuring device 130, and that such principles can be implemented
23 by way of any of a number of various known means. It is further understood that the
24 support device 130, in any of its various possible specific configurations, can be
25 configured as an accessible tray or the like (not shown). Such accessible trays are
26 known and widely employed in the art, and are configured to open and close in order to
27 allow a user to form a new media stack by adding additional media sheets to the support
28 device. For example, such media trays are commonly configured to open and close in
29 the manner of a drawer.

30 Thus, for example, when the stack MS becomes low or completely depleted, a
31 user can then open the accessible tray and insert additional media sheets onto the
32 support device to form a new stack thereon. In such a configuration of an accessible
33 tray, the support device 130 can also include a sensor (not shown) that is adapted to
34 detect if the tray is open or closed, the significance of which becomes more apparent in
35 later discussion.

1 Turning back to Fig. 1, the apparatus 100 can also include a counting device 140.
2 The counting device 140 is configured to generate count data indicative of the number of
3 media sheets MM that are dispensed from the stack MS during a given time period.
4 That is, the counting device 140 is configured to detect and count, or keep track of, how
5 many media sheets MM are dispensed from the stack MS between a first event and a
6 second event.

7 Counting devices are generally known in the art, and the counting device 140 can
8 have any of a number of known forms. For example, the counting device 140 can be a
9 top-of-form detector that is configured to detect and count the number of media sheets
10 MM that pass a given point on the media path PP downstream of the picking device 120.
11 Top-of-form detectors are known and are widely employed in various devices that are
12 configured to process media sheets such as the media sheets MM.

13 The apparatus 100 can also include a processor 150. The processor 150 can
14 have any of a number of known forms including programmable logic computers,
15 processing "chips," and the like. The processor 150 is configured to execute a set of
16 computer executable instructions 152 to thus enable the processor to perform
17 computations and to make decisions based thereupon. The set of computer executable
18 instructions 152 can include a plurality of individual computer executable steps 153.

19 The apparatus 100 can also include a memory device 160 that is adapted to
20 store data therein, which data is retrievable by the processor 150. For example, the
21 memory device 160 can be adapted to store the set of computer executable steps
22 therein for access by the processor 150. Memory devices are known in the art and can
23 include, for example, a semiconductor memory device.

24 As is depicted, the processor 150 can be in data-communicative linkage with one
25 or more of the support device 110, the picking device 120, the measuring device 130,
26 the counting device 140, and the memory device 160. The term "data-communicative
27 linkage" as used herein is defined as being connected so as to allow the transmission of
28 data signals to and/or from.

29 As is also shown in Fig. 1, the processor 150 can be in data-communicative
30 linkage with the processing section 200. Furthermore, the processor 150 can be
31 configured to perform controlling functions with regard to any processes to be carried out
32 by the processing section 200. That is, for example, in the case wherein the processing
33 section 200 is an imaging section, the processor 150 can be configured to control the
34 imaging process to be carried out by the processing section.

1 More specifically, in the case wherein the processing section 200 is an imaging
2 section, the processor 150 can be configured to control the execution of a print job
3 queue 300 by the processing section. The print job queue 300 can include a plurality of
4 individual print jobs 310. Each print job 310 can be, for example, a separate document
5 or the like. However, regardless of whether the processor 150 is configured to control
6 the operation of the processing section 200, the set of computer executable instructions
7 152 can be operatively resident within the memory device 160 and executable by the
8 processor.

9 Furthermore, the set of computer executable instructions 152 can be adapted to
10 cause the processor 150 to compute an estimated number of media sheets remaining in
11 the stack MS based on the count data and the measurement data. That is, the set of
12 computer executable instructions 152 can be configured to cause the processor 150 to
13 compute an estimated number of media sheets MM remaining in the stack MS based on
14 data detected by the counting device 140 and the measuring device 130.

15 More specifically, the set of computer executable instructions 152 can be adapted
16 to cause the processor 150 to compute an estimated number of media sheets MM
17 remaining in the stack MS based on a change in a quantitative measurement of the
18 stack MS and a corresponding number of media sheets MM that are dispensed from the
19 stack, wherein the dispensation of the corresponding number of media sheets from the
20 stack results in the change in the quantitative measurement. Such a computation of the
21 estimated number of media sheets MM remaining in the stack MS is explained in greater
22 detail below.

23 It is understood that, although not depicted, the apparatus 100 can include any
24 number of additional elements and/or devices. For example, the apparatus 100 can
25 include a chassis (not shown) on which any of the aforementioned components can be
26 supported. Furthermore, an enclosure (not shown) can be provided to enclose one or
27 more of the aforementioned devices. It is further understood that up to and including all
28 of the aforementioned devices and components can be combined and/or incorporated
29 into a single unitary apparatus.

30 With reference now to Fig. 4, a flow diagram is shown in which an operational
31 sequence 400 is depicted. The operational sequence 400 generally illustrates a basic
32 method of obtaining an estimated number of media sheets in a stack of media sheets in
33 accordance with various embodiments of the present invention, wherein such a method
34 can be employed by the apparatus 100 depicted in Fig. 1 and which is described briefly
35 above.

1 Still referring to Fig. 4, from the beginning 401 of the operational sequence 400,
2 the sequence proceeds next to step 403. In accordance with step 403, a first
3 quantitative measurement is performed on the stack of media sheets. That is, in
4 accordance with step 403, a first value for a quantitative measurement of the stack is
5 obtained. The first measurement of the quantitative characteristic can be an initial
6 measurement of the stack before any media sheets are dispensed therefrom.
7 Alternatively, the first quantitative measurement can be performed at any time after
8 dispensation of media sheets from the stack is commenced.

9 As is discussed above, the quantitative characteristic can be any characteristic
10 that can be measured and that gives a relative indication of the quantity of media sheets
11 in the stack. For example, as is also mentioned above, the quantitative characteristic
12 can be the thickness, or height, of the stack. Alternatively, the quantitative characteristic
13 can be the weight, or mass, of the stack.

14 The value of the quantitative characteristic measurement can be represented by
15 "Q_n," where "n" refers to the nth measurement. Thus, the first value obtained by the first
16 measurement of the quantitative characteristic can be represented by "Q₁." It can be
17 appreciated that the measuring device 130 can be employed to perform measurements
18 of the quantitative characteristics, as is explained above with reference to Fig. 1.

19 Proceeding from step 403 to step 405, a counter is initiated, wherein n=1. The
20 significance of this becomes apparent in the discussion below. From step 405, the
21 sequence 400 moves to step 407 in accordance with which at least one individual media
22 sheet is dispensed from the media stack. Furthermore, in accordance with step 407, the
23 number of media sheets dispensed from the stack is counted from the time at which the
24 first quantitative measurement is made.

25 That is, in accordance with step 407, after the first quantitative measurement of
26 the stack is made, individual media sheets are dispensed from the media stack and are
27 counted. The number of media sheets counted since the first quantitative measurement
28 is made can be represented by "N." The process of dispensing individual media sheets
29 from the stack can be accomplished by the picking device 120 as is described above
30 with reference to Fig. 1. As is also discussed above with reference to Fig. 1, the process
31 of counting the number of media sheets dispensed since the first quantitative
32 measurement is obtained can be accomplished by the counting device 140.

33 With continued reference to Fig. 4, the next step in the sequence 400 is that of
34 step 409. As is seen, step 409 is a query that asks if the next quantitative measurement
35 should be performed, or obtained. That is, step 409 asks whether the next quantitative

1 measurement Q_2 should be obtained. The resolution of the query of step 409 can be
2 based on any of a number of criteria.

3 For example, the answer to the query of step 409 can be based on elapsed time.
4 More specifically, the value of the second measurement (Q_2) of the quantitative
5 characteristic can be performed after a predetermined period of time has elapsed from a
6 predefined event. As yet a more specific example, the value of the second
7 measurement can be performed at the expiration of a predetermined period of time,
8 which period of time commences when the first value (Q_1) of the quantitative
9 measurement is obtained.

10 As yet a further example, the second measurement of the quantitative
11 characteristic can be performed after a predetermined number of media sheets have
12 been dispensed from the media stack. As yet still another example, the second
13 quantitative measurement can be a predetermined set point. That is, the measuring
14 device 130 (shown in Fig. 1) can be configured to transmit a signal when the quantitative
15 characteristic reaches a given predetermined value. More specifically, for example, the
16 measuring device 130 can be configured to transmit a data signal to the processor at the
17 moment the media stack MS (shown in Fig. 1) reaches a predefined height.

18 In any case, if the answer to the query of step 409 is "no," then the sequence 400
19 returns to step 407 in accordance with which the dispensing and counting of individual
20 media sheets continues. However, if the answer to the query of step 409 is "yes," then
21 the sequence 400 proceeds to step 411 which causes the counter to increment. From
22 step 411, the sequence 400 proceeds to step 413 in accordance with which the "nth"
23 quantitative measurement is obtained.

24 From step 413, the sequence 400 moves to step 415. In accordance with step
25 415, a difference D_{n-1} is computed. More specifically, in accordance with step 415, the
26 difference D_{n-1} is computed, wherein $D_{n-1} = (Q_1 - Q_n)$. Thus, the first difference D_1 is
27 equal to the difference between the first quantitative measurement Q_1 and the second
28 quantitative measurement Q_2 . The computation of the difference D_{n-1} can be performed
29 by the processor 150 in conjunction with the set of computer executable instructions 152
30 (both shown in Fig. 1). The significance of the difference D_{n-1} becomes apparent in the
31 following discussion.

32 Still referring to Fig. 4, the sequence 400 proceeds from step 415 to step 417. In
33 accordance with step 417, a ratio R_{n-1} is computed, wherein $R_{n-1} = (N/D_{n-1})$. It is
34 understood that "N" is the number of media sheets that are dispensed from the stack
35 after the first quantitative measurement is obtained, and up until the nth quantitative

1 measurement is obtained. That is, "N" is the number of media sheets that are dispensed
2 from the media stack between the first quantitative measurement and the nth
3 quantitative measurement.

4 Thus, as is indicated by the equation, $R_{n-1} = (N/D_{n-1})$, the ratio is equal to a given
5 number of media sheets dispensed from the stack to a change in the quantitative
6 characteristic of the stack, wherein the change in the quantitative characteristic
7 corresponds to the given number of media sheets. That is, for example, the first ratio is
8 equal to the number of media sheets dispensed between the first and second
9 quantitative measurements divided by the difference between the first and second
10 quantitative measurements.

11 From step 417, the sequence 400 moves to step 419. In accordance with step
12 419, the estimated number ("E") of media sheets remaining in the stack is calculated.
13 That is, $E = (Q_n) \times (R_{n-1})$. In other words, $E = (Q_n) \times [N/(Q_1 - Q_n)]$. Thus, in summary,
14 the estimated number of media sheets remaining in the stack can be computed by first
15 obtaining a first measurement of the quantitative characteristic and then obtaining a
16 second measurement of the quantitative characteristic while counting the number of
17 media sheets that are dispensed from the stack between the two measurements.

18 Thereafter a ratio is computed, wherein the ratio is the number of media sheets
19 counted divided by the difference in the first and second quantitative measurements.
20 The ratio is then multiplied by the second quantitative measurement to obtain the
21 estimated number of media sheets remaining in the stack. It is understood that the
22 sequence 400 depicts a specific example of a method in accordance with one
23 embodiment of the present invention. That is, specifically, in accordance with the
24 sequence 400, the method of estimating the number of media sheets remaining in the
25 stack always employs the first measurement of the quantitative characteristic.

26 However, it can be appreciated that the method depicted by the sequence 400
27 can be modified slightly, wherein any two measurements of the quantitative
28 characteristic can be employed to compute an estimated number of media sheets in the
29 stack. It can also be appreciated that, as the number of media sheets dispensed ("N")
30 between two associated measurements of the quantitative characteristic increases, the
31 accuracy of the estimation of the number of media sheets in the stack generally
32 increases. Therefore, it can be advantageous to obtain the first quantitative
33 measurement before, or shortly after, the commencement of dispensation of media
34 sheets from the stack.

1 From step 419, the sequence 400 proceeds to step 421 that is another query.
2 The query of step 421 asks whether another estimation of the number of media sheets in
3 the stack is to be computed. The answer to the query of step 421 can depend upon any
4 of a number of criteria. For example, the answer to the query of step 421 can depend
5 upon the last estimate of the number of media sheets in the stack. More specifically, for
6 example, a predetermined number of media sheets can be established, wherein if the
7 estimated number of media sheets in the stack is below the predetermined number, then
8 no additional estimations are to be performed.

9 In any case, if the answer to the query of step 421 is "yes," then the sequence
10 400 proceeds to step 407, in accordance with which additional media sheets are
11 dispensed from the media stack and are counted as they are dispensed. On the other
12 hand, if the answer to the query of step 421 is "no," then the sequence 400 proceeds to
13 the end 423.

14 Moving now to Fig. 5, a flow diagram is shown in which another operational
15 sequence 500 is depicted. It is understood that the operational sequence 500 can be
16 accomplished by the apparatus 100 that is described above and shown in Fig. 1.
17 Basically, the operational sequence 500 describes a method of employing several ratios
18 such as the ratio described above with reference to Fig. 4, wherein the several ratios can
19 be employed to generally increase the accuracy with which an estimation of the number
20 of media sheets remaining in the stack can be performed.

21 Still referring to Fig. 5, the operational sequence 500 proceeds from the
22 beginning 501 to step 503 in accordance with which a counter is initiated. From step
23 503, the sequence 500 moves to step 505. At step 505, the media tray is detected to be
24 open. That is, in accordance with step 505, the support device 110 (shown in Fig. 1) is
25 detected to be accessible by a user. In that case, it can be assumed that media sheets
26 can be added to the media stack supported on the support device, or media tray.

27 From step 505, the sequence 500 proceeds to step 507 which is a query. The
28 query of step 507 asks if the media tray has been closed. While the media tray remains
29 open, the sequence 500 remains in a loop through steps 505 and 507. That is, if the
30 answer to the query of step 507 is "no," then the sequence returns to step 505.

31 However, when the media tray is detected to have been closed, the answer to the
32 query of step 507 is "yes." In that case, the sequence 500 proceeds from step 507 to
33 step 509. It is understood that when the media tray has been closed, it can be assumed
34 that the tray is no longer accessible to any user. In accordance with step 509,

1 dispensation by the picking device 120 (shown in Fig. 1) of media sheets from the media
2 stack which is supported on the support device, or media tray, is commenced.

3 From step 509, the sequence 500 proceeds to step 511. Step 511 dictates that
4 at least one ratio R_n , wherein "n" references the "nth media stack." That is, for example,
5 one or more ratios R_1 can be calculated for a first stack, and one or more ratios R_2 can
6 be calculated for a second stack, and so on. It is understood that the term "stack" as
7 used herein refers to a stack of media sheets, wherein no media sheets are added to the
8 stack after the stack is placed on the support device, and wherein dispensation of media
9 sheets from the stack has commenced.

10 Furthermore, it is understood that the ratio R_n is calculated based on both the
11 number of media sheets counted by the counting device 140 (shown in Fig. 1) and the
12 difference in the corresponding quantitative measurements obtained via the measuring
13 device 130 (also shown in Fig. 1). It can be recalled that a method of computing such a
14 ratio in accordance with one embodiment of the present invention is explained above
15 with reference to the operational sequence 400 shown in Fig. 4. Furthermore, it can be
16 appreciated that various data, such as the count data and the ratios which are generated
17 in accordance with the various procedures of the sequence 500, can be stored in the
18 memory device 160 (shown in Fig. 1) for later recall.

19 The sequence 500 proceeds from step 511 to step 513, which is a query. The
20 query of step 513 asks whether the media tray has been opened. In other words, the
21 query of step 513 asks whether the support device 110 (shown in Fig. 1) has been
22 rendered accessible to a user such that the user is able to add media to the support
23 device to form a new stack. If the answer is "no," then the sequence 500 returns to step
24 509 in accordance with which the process of dispensing media sheets from the nth stack
25 continues. Furthermore, additional ratios can be calculated for the nth stack in
26 accordance with step 511.

27 When the media tray is opened, then the answer to the query of step 513 is "yes,"
28 and the sequence 500 proceeds to step 515. It is understood that when the media tray
29 is opened, it can be assumed that additional media sheets are added thereto in order to
30 form a new stack. Thus, when the media tray is detected to have been opened, it can
31 be assumed that the life of the nth stack has ended and a new stack has been formed.

32 Accordingly, step 515 dictates that a representative ratio of the nth stack is
33 selected. A "representative ratio" of the nth stack can be, for example, a ratio of the nth
34 stack that is considered to be the most accurate of the ratios calculated for the nth stack.
35 More specifically, for example, if the method described above with reference to the

1 sequence 400 shown in Fig. 4 is employed to compute the ratios for the nth stack, then
2 the last ratio computed can generally be considered to be the most accurate ratio. Thus,
3 in such a case, the last ratio computed for the nth stack before the media tray is
4 detected to have been opened can be selected as the representative ratio of the nth
5 stack RR_n . The representative ratio for the nth stack can then be stored in the memory
6 device 160 (shown in Fig. 1) for later recall.

7 From step 515, the sequence 500 proceeds to step 517. In accordance with step
8 517, a mean value (MV) can be computed for all representative ratios calculated thus
9 far. That is, as additional representative ratios are obtained for each of an increasing
10 number of stacks, the mean value can be updated by including each new representative
11 value in a recalculation thereof.

12 For example, for the representative ratio of the first stack, the mean value is the
13 same as the representative value for a first stack, since there is only one representative
14 ratio. After the representative ratio of a second stack is obtained, the mean value is
15 updated and is equal to the average of the representative ratios of the first stack and the
16 second stack, respectively. Furthermore, after the representative ratio of a third stack is
17 obtained, the mean value is updated and recalculated to be equal to the average of the
18 representative ratios of the first stack, the second stack, and the third stack, respectively.

19 It is understood that the step 517, in accordance with an alternative embodiment
20 of the method illustrated by the sequence 500, can dictate that the median value for all
21 representative ratios is determined, rather than the mean value. Also, as is indicated by
22 step 517, the mean value (or median value) can be used to compute the number of
23 media sheets remaining in a given stack. Furthermore, the utilization of the mean value
24 (or median value) to compute the number of media sheets remaining in a given stack
25 can be independent of the sequence 500. That is, step 517 need not include the
26 utilization of the mean value (or median value) to compute the number of media sheets
27 remaining in a given media stack as an integral part of the sequence 500.

28 As a more specific explanation of the step 517, and as is discussed above with
29 reference to the operational sequence 400 shown in Fig. 4, the number of media sheets
30 remaining in a given stack can be computed by multiplying a ratio (the determination of
31 which is discussed above) by a given value of a measurement of the quantitative
32 characteristic. However, the number of sheets remaining in a given stack can
33 alternatively be computed by multiplying the mean value (or median value) by a given
34 value of a measurement of the quantitative characteristic.

1 With continued reference to Fig. 5, the sequence 500 proceeds from step 517 to
2 step 521, which is another query. The query of step 521 asks whether the process of
3 determining the mean value (or median value) should be continued. If the answer to the
4 query of step 521 is "yes," then the sequence 500 moves to step 522 in accordance with
5 which the counter is incremented. From step 522, the sequence 500 returns to step 507
6 which queries whether the media tray has been closed. On the other hand, if the answer
7 to the query of step 521 is "no," then the sequence 500 ends at 523.

8 Turning now to Fig. 6, yet another flow diagram is shown in which yet another
9 operational sequence 600 is depicted. The operational sequence 600 generally
10 represents a method in accordance with one embodiment of the present invention for
11 employing a mean value (or median value), as is explained above with respect to the
12 operational sequence 500 shown in Fig. 5, to process a plurality of print jobs.

13 The operational sequence 600 begins at 601 and proceeds to step 603 in
14 accordance with which a counter is initialized, wherein $n=1$. From step 603, the
15 sequence 600 proceeds to step 605. In accordance with step 605, the number of media
16 sheets remaining in a given stack can be estimated by employing the mean value (or
17 median value) as is explained above with respect to step 519 of the sequence 500, and
18 which is shown in Fig. 5.

19 From step 605, the sequence 600 moves to step 607. In accordance with step
20 607, the n th print job in a queue of print jobs is evaluated to determine if there is
21 sufficient media in the media tray to complete the n th print job. This can be
22 accomplished by the set of computer executable instructions 152 (shown in Fig. 1) in
23 conjunction with the processor 150 (also shown in Fig. 1), wherein the number of pages
24 in the n th print job is determined.

25 That is, the n th print job can be examined to determine the number of pages
26 required to complete the n th print job. This number can then be compared to the
27 estimated number of media sheets remaining in the tray as is computed in step 605 and
28 which is explained above in detail with respect to step 519 of the sequence 500 shown in
29 Fig. 5.

30 Still referring to Fig. 6, various known statistical methods can be employed by the
31 set of computer executable instructions 152 to determine, within a predetermined
32 confidence level, whether a sufficient quantity of media sheets remain in the tray to
33 complete the n th print job. For example, as indicated, the confidence level can be
34 selected to be 95% or greater.

1 Moving on from step 607 to step 609, a query asks if there is a sufficient quantity
2 of media sheets remaining in the media tray to complete the nth print job. If the answer
3 to the query of step 609 is "yes," then the sequence 600 proceeds from step 609 to step
4 611 in accordance with which the nth print job is printed. From step 609, the sequence
5 600 moves to step 613, wherein the counter is incremented such that $n=n+1$.

6 From step 613, the sequence 600 returns to step 607 in accordance with which
7 the next print job is evaluated to determine if the number of media sheets remaining after
8 printing the previous print job is sufficient to complete the next print job. It can be
9 appreciated that, because the number of pages of the previous print job are known, that
10 number can be subtracted from the previous estimated number of media sheets
11 remaining in the stack to result in an updated estimate of the number of media sheets
12 remaining in the stack. Alternatively, however, the sequence 600 can proceed from step
13 613 to step 605 in accordance with which another estimate of the number of media
14 sheets remaining in the stack is performed.

15 In any case, if the answer to the query of step 609 is "no," then the sequence 600
16 proceeds to step 615 which is another query. The query of step 615 asks whether there
17 are any additional print jobs in the print job queue. If there are additional print jobs in the
18 print job queue, then the answer to the query of step 615 is "yes," and the sequence 600
19 moves to step 617, wherein the counter is incremented such that $n=n+1$. From step
20 617, the sequence 600 returns to step 607 in accordance with which the next print job in
21 the print job queue is evaluated to determine if the number of media sheets in the stack
22 is sufficient to print the next print job.

23 However, if no additional print jobs remain in the print job queue, then the answer
24 to step 615 is "no," and the sequence 600 moves to step 619. In accordance with step
25 619, a signal is transmitted, wherein the signal notifies the user to refill the media tray
26 with additional media sheets so as to form a new stack. When the media tray is refilled
27 and a new stack is formed in accordance with step 619, the sequence 600 proceeds to
28 step 621 which is yet another query.

29 The query of step 621 asks whether the process of evaluating print jobs should
30 continue. If the answer to the query of step 621 is "yes," then the sequence 600 returns
31 to step 603 in accordance with which the counter is re-initialized such that $n=1$ again.
32 However, if the answer to the query of step 621 is "no," then the sequence 600 ends at
33 623.

34 Returning now to Fig. 1, it can be appreciated in light of the above discussion
35 with respect to the operational sequence 400 shown in Fig. 4, that the set of computer

1 executable instructions 152 can be adapted to cause the processor 150 to calculate a
2 ratio of a given change in the quantitative characteristic to a corresponding number of
3 media sheets dispensed from the stack.

4 Furthermore, it can also be appreciated in light of the above discussion with
5 respect to the operational sequence 400 shown in Fig. 4, that the set of computer
6 executable instructions 152 can be further adapted to cause the processor 150 to
7 compute an estimated number of media sheets remaining in the stack MS based on the
8 ratio and a measurement datum indicative of the quantitative characteristic of the stack,
9 wherein the measurement datum is generated by the measuring device 130 as is
10 discussed above.

11 Still referring to Fig. 1, it can further be appreciated in light of the above
12 discussion with respect to the operational sequence 500 shown in Fig. 5, that the set of
13 computer executable instructions 152 can also be adapted to cause the processor 150
14 to compute a plurality of ratios, wherein each ratio is a ratio of a respective change in the
15 quantitative characteristic to a respective corresponding number of media sheets
16 dispensed from the stack.

17 Also, in light of the above discussion with respect to the operational sequence
18 500 shown in Fig. 5, the set of computer executable instructions 152 can be adapted to
19 cause the processor 150 to calculate a mean value for the plurality of ratios.
20 Furthermore, as is explained above, the set of computer executable instructions 152 can
21 alternatively be adapted to cause the processor 150 to calculate a median value for the
22 plurality of ratios.

23 In accordance with another embodiment of the present invention, a method of
24 dispensing media sheets from a stack of media sheets includes obtaining a first
25 quantitative measurement of the stack, and obtaining a second quantitative
26 measurement of the stack. Also, the method includes dispensing at least one media
27 sheet from the stack between the time the first measurement is made and the time the
28 second measurement is made.

29 That is, at least one media sheet is dispensed between the first quantitative
30 measurement and the second quantitative measurement. It is understood that media
31 sheets such as the media sheets MM shown in Fig. 1 can be dispensed in accordance
32 with the method by way of a picking device such as the picking device 120 described
33 above with reference to Fig. 1.

34 Such quantitative measurements can be obtained in accordance with the method
35 by way of a measuring device such as the measuring device 130 described above with

1 reference to Fig. 1, as well as the measuring devices 130A and 130B described above
2 with reference to Figs. 2 and 3 respectively. That is, for example, the process of
3 obtaining a quantitative measurement of the stack can include measuring the thickness,
4 or the height, of the stack. Alternatively, for example, the process of obtaining a
5 quantitative measurement of the stack can include weighing the stack, or determining its
6 mass.

7 The method can also include establishing a difference by subtracting the second
8 quantitative measurement from the first quantitative measurement. Such a calculation of
9 the difference can be performed by a set of computer executable instructions such as
10 the set of computer executable instructions 152 described above with reference to
11 Fig. 1. That is, the computer executable instructions 152 can be adapted to establish
12 the difference in accordance with the method.

13 Also in accordance with the method, a count is established by counting the media
14 sheets that are dispensed from the stack between the first quantitative measurement
15 and the second quantitative measurement. Such a count can be established by a
16 counting device such as the counting device 140 described above with reference to
17 Fig. 1. That is, the counting device 140 can be adapted to count the number of media
18 sheets MM in accordance with the method.

19 A ratio is also established in accordance with the method. That is, the method
20 includes establishing a ratio by dividing the count by the difference. The establishment
21 of such a ratio can be performed by way of the set of computer executable instructions
22 152 in conjunction with the processor 150. Furthermore, examples of establishing the
23 difference, as well as establishing the ratio are discussed above with reference to the
24 operational sequence 400 shown in Fig. 4.

25 Additionally, the method includes establishing an estimated quantity of media
26 sheets remaining in the stack by multiplying the second quantitative measurement by the
27 ratio. This process of establishing an estimated number of media sheets remaining in
28 the media stack can be performed by the set of computer executable instructions 152 in
29 conjunction with the processor 150. An example of this process is also described above
30 with respect to the operational sequence 400 shown in Fig. 4.

31 The method can also include determining that the estimated quantity of media
32 sheets remaining in the stack is low. This can be performed in response to establishing
33 the estimated quantity of media sheets remaining in the stack. That is, for example, a
34 predetermined set point of a given number of media sheets can be defined. If, in
35 accordance with the method, the number of media sheets remaining in the stack is

1 estimated, and that number is determined to be less than the set point, then the
2 determination has been made that the quantity of media sheets remaining in the stack is
3 low. These processes can be performed by the set of computer executable instructions
4 152 in conjunction with the processor 150.

5 Furthermore, an "add media" signal can be transmitted in response to
6 determining that the estimated quantity of media sheets remaining in the stack is low.
7 This process can also be performed by the set of computer executable instructions 152
8 in conjunction with the processor 150. The add media signal can be any signal that can
9 be detected by a user and that can be interpreted as indicating that the quantity of media
10 sheets remaining in the stack is low. For example, the add media signal can be an
11 audible "beep." Alternatively, the add media signal can be a visual flashing light, or the
12 like.

13 After the first and second quantitative measurements are obtained, a third
14 quantitative measurement of the stack can then be obtained as well. The third
15 quantitative measurement can then be multiplied by the ratio to establish an estimated
16 quantity of media sheets remaining in the stack. In other words, after the first and
17 second quantitative measurements are obtained, and after the associated estimated
18 quantity of media sheets remaining in the stack is established as discussed above,
19 additional media sheets can be dispensed from the stack.

20 Thus, when additional media sheets are dispensed from the stack after the
21 estimated quantity of media sheets remaining in the stack is established, that quantity
22 becomes inaccurate. Accordingly, the previously established ratio as discussed above
23 can be used along with the third quantitative measurement to establish an updated
24 estimated quantity of media sheets remaining in the stack.

25 Alternatively, when a third quantitative measurement is established, an updated
26 difference can be established by subtracting the third quantitative measurement from the
27 first quantitative measurement. Similarly, an updated count can be established by
28 counting the number of media sheets that are dispensed from the stack between the first
29 quantitative measurement and the third quantitative measurement. Likewise, an
30 updated ratio can be established by dividing the updated count by the updated
31 difference. Finally, an updated estimated quantity of media sheets remaining in the
32 stack can be established by multiplying the third quantitative measurement by the
33 updated ratio.

34 As yet another alternative, when a third quantitative measurement is obtained an
35 updated difference can be established by subtracting the third quantitative measurement

1 from the second quantitative measurement. Similarly, an updated count can be
2 established by counting the number of media sheets that are dispensed from the stack
3 between the second quantitative measurement and the third quantitative measurement.
4 An updated ratio can then be established by dividing the updated count by the
5 associated updated difference. An updated estimated quantity of media sheets
6 remaining in the stack can be established by multiplying the third quantitative
7 measurement by the updated ratio.

8 A proposed print job can be provided in accordance with the method. An
9 evaluation can then be made as to whether the estimated quantity of media sheets
10 remaining in the stack is sufficient to complete the proposed print job. As is discussed
11 above, this evaluation can be made so as to maintain a predetermined minimum level of
12 confidence with regard to whether the estimated quantity of media sheets remaining in
13 the stack is sufficient to complete the proposed print job. As is also discussed above,
14 such a predetermined minimum level of confidence can be maintained by way of known
15 methods of statistical analysis.

16 As a result of the aforementioned evaluation to determine if the stack contains a
17 sufficient number of media sheets to complete the proposed print job, a determination
18 can be made that the number of media sheets contained in the stack is not sufficient to
19 complete the proposed print job. Accordingly, an "add media" signal can be transmitted
20 in response to determining that the estimated quantity of media sheets in the stack is not
21 sufficient to complete the proposed print job.

22 A plurality of proposed print jobs can be provided in accordance with the method.
23 That is, at least a first proposed print job and a second proposed print job can be
24 provided. In that case, an evaluation can be made as to whether the estimated quantity
25 of media sheets remaining in the stack is sufficient to complete the first proposed print
26 job. Accordingly, a determination can be made that the quantity of media sheets
27 remaining in the stack is not sufficient to complete the first proposed print job.

28 If such a determination is made, then in response thereto another evaluation can
29 be made as to whether the estimated quantity of media sheets remaining in the stack is
30 sufficient to complete the second proposed print job. Accordingly, after such an
31 evaluation, a determination can be made that the estimated quantity of media sheets
32 contained in the stack is sufficient to complete the second proposed print job. In such a
33 case, the second proposed print job can be printed in response to determining that the
34 estimated quantity of media sheets contained in the stack is sufficient to complete the
35 second proposed print job.

1 In one variation of the above described method, two or more different processes
2 of obtaining a quantitative measurement of the stack (e.g., weighing and measuring the
3 height) can be used, and the estimated number of media sheets remaining in the stack
4 MS using each quantitative measurement can then be combined and/or averaged to
5 produce an estimate of the number of media sheets remaining in the stack. That is, two
6 or more different types of quantitative characteristics, such as the stack weight and the
7 stack height, can be utilized to obtain an estimated number of media sheets remaining in
8 the stack.

9 For example, a difference in stack weight can be obtained for a given media
10 stack as is described above. Furthermore, a difference in stack height can also be
11 obtained for the given media stack. The difference in stack weight and the difference in
12 stack height can be obtained either concurrently or successively, or the like. A
13 respective estimated number of media sheets remaining in the stack can be determined
14 for each difference as is described above in detail. Thereafter, these estimates can be
15 compared and/or averaged in furtherance of determining an estimated number of media
16 sheets remaining in the given media stack.

17 In accordance with another embodiment of the present invention, a method of
18 dispensing media sheets from a stack of media sheets includes dispensing a number of
19 media sheets from the stack, wherein the number of media sheets includes at least a
20 first media sheet and a last media sheet. That is, the first media sheet is the first of the
21 number of media sheets to be dispensed from the stack, while the last media sheet is
22 the last of the number of media sheets to be dispensed from the stack.

23 The method also includes determining an initial thickness of the stack before the
24 first media sheet is dispensed from the stack, and determining a final thickness of the
25 stack after the last media sheet is dispensed from the stack. More specifically, the initial
26 thickness of the stack is determined such that the first media sheet is the first media
27 sheet dispensed from the stack after determining the initial thickness of the stack.
28 Moreover, the final thickness of the stack is determined such that the last media sheet is
29 the last media sheet dispensed from the stack before determining the final thickness of
30 the stack.

31 Also in accordance with the method, the difference in the initial thickness of the
32 stack and the final thickness of the stack is determined. That is, the difference between
33 the initial thickness of the stack and the final thickness of the stack can be determined by
34 subtracting the final thickness from the initial thickness. A ratio can then be established,
35 wherein the ratio can be equal to the number of media sheets dispensed from the stack

1 divided by the difference between the initial thickness of the stack and the final thickness
2 of the stack.

3 Thus, the number of media sheets dispensed from the stack, wherein the number
4 comprises at least the first media sheet and the last media sheet, corresponds to the
5 difference between the initial thickness of the stack and the final thickness of the stack.
6 That is, the dispensation of the number of media sheets from the stack, wherein the
7 number of sheets dispensed includes at least the first media sheet and the last media
8 sheet, accounts for the difference between the initial thickness of the stack and the final
9 thickness of the stack.

10 An estimated quantity of media sheets remaining in the stack can then be
11 established by multiplying the ratio by the final thickness of the stack. That is, the
12 estimated quantity of media sheets remaining in the stack after the last media sheet is
13 dispensed from the stack, but before any other media sheets are subsequently
14 dispensed from the stack, can be established by multiplying the ratio by the final
15 thickness of the stack.

16 In accordance with yet another embodiment of the present invention, a similar
17 method of dispensing media sheets from a stack of media sheets also includes
18 dispensing a number of media sheets from the stack of media sheets, wherein the
19 number of media sheets includes a first media sheet and a last media sheet. As in the
20 previously discussed method, the first media sheet is the first media sheet of the number
21 of media sheets to be dispensed from the stack, while the last media sheet is the last of
22 the number of media sheets to be dispensed from the stack.

23 The method also includes determining an initial weight of the stack before the first
24 media sheet is dispensed from the stack, and determining a final weight of the stack
25 after the last media sheet is dispensed from the stack. More specifically, the initial
26 weight of the stack is determined such that the first media sheet is the first media sheet
27 dispensed from the stack after determining the initial weight of the stack. Moreover, the
28 final weight of the stack is determined such that the last media sheet is the last media
29 sheet dispensed from the stack before determining the final weight of the stack.

30 Also in accordance with the method, the difference in the initial weight of the
31 stack and the final weight of the stack is determined. That is, the difference in the initial
32 weight of the stack and the final weight of the stack can be determined by subtracting
33 the final weight from the initial weight. A ratio can then be established, wherein the ratio
34 can be equal to the number of media sheets dispensed from the stack divided by the
35 difference between the initial weight of the stack and the final weight of the stack.

1 Thus, the number of media sheets dispensed from the stack, wherein the number
2 comprises at least the first media sheet and the last media sheet, corresponds to the
3 difference between the initial weight of the stack and the final weight of the stack. That
4 is, the dispensation of the number of media sheets from the stack, wherein the number
5 of sheets dispensed includes at least the first media sheet and the last media sheet,
6 accounts for the difference between the initial weight of the stack and the final weight of
7 the stack.

8 An estimated quantity of media sheets remaining in the stack can then be
9 established by multiplying the ratio by the final weight of the stack. That is, the
10 estimated quantity of media sheets remaining in the stack after the last media sheet is
11 dispensed from the stack, but before any other media sheets are subsequently
12 dispensed from the stack, can be established by multiplying the ratio by the final weight
13 of the stack.

14 In accordance with yet another embodiment of the present invention, a method of
15 dispensing media sheets from a stack of media sheets includes dispensing a first
16 plurality of media sheets from the stack. However, a first quantitative measurement of
17 the stack is obtained before the first plurality of media sheets is dispensed from the
18 stack. Also, a second quantitative measurement of the stack is obtained after the first
19 plurality of media sheets is dispensed from the stack.

20 A first delta measurement is established by subtracting the second quantitative
21 measurement from the first quantitative measurement. That is, the first delta
22 measurement is the difference between the first quantitative measurement and the
23 second quantitative measurement. A first count is also established by counting the
24 media sheets that make up the first plurality of media sheets. That is, the first count is
25 established by counting the number of media sheets that are dispensed from the stack
26 between the first quantitative measurement and the second quantitative measurement.

27 A first ratio can then be established by dividing the first count by the first delta
28 measurement. That is, the first ratio can be defined as the first count divided by the first
29 delta measurement, wherein the first delta measurement can be obtained by subtracting
30 the second quantitative measurement from the first quantitative measurement. Thus,
31 the first ratio can describe the relationship between the first plurality of media sheets
32 dispensed from the stack and the associated difference in the first and second
33 quantitative measurements.

34 Similarly, the method includes dispensing a second plurality of media sheets from
35 the stack after the second quantitative measurement is obtained. Also, a third

1 quantitative measurement of the stack is obtained before the second plurality of media
2 sheets is dispensed from the stack. Also, a fourth quantitative measurement of the stack
3 is obtained after the second plurality of media sheets is dispensed from the stack.

4 A second delta measurement is established by subtracting the fourth quantitative
5 measurement from the third quantitative measurement. That is, the second delta
6 measurement is the difference between the third quantitative measurement and the
7 fourth quantitative measurement. A second count is also established by counting the
8 media sheets that make up the second plurality of media sheets. That is, the second
9 count is established by counting the number of media sheets that are dispensed from
10 the stack between the third quantitative measurement and the fourth quantitative
11 measurement.

12 A second ratio can then be established by dividing the second count by the
13 second delta measurement. That is, the second ratio can be defined as the second
14 count divided by the second delta measurement, wherein the second delta
15 measurement can be obtained by subtracting the fourth quantitative measurement from
16 the third quantitative measurement. Thus, the second ratio can describe the relationship
17 between the second plurality of media sheets dispensed from the stack and the
18 associated difference in the third and fourth quantitative measurements.

19 An average of the first ratio and the second ratio can be calculated in accordance
20 with the method. That is, the first ratio and the second ratio can be added together, and
21 then divided in half to obtain an average value for the first ratio and the second ratio. A
22 fifth quantitative measurement of the stack can be obtained after the fourth quantitative
23 measurement is obtained. Furthermore, an estimated quantity of media sheets
24 remaining in the stack can be established by multiplying the fifth quantitative
25 measurement by the average of the first ratio and the second ratio.

26 Also in accordance with the method, a proposed print job can be provided. An
27 evaluation can be made in accordance with the method to determine whether the
28 estimated quantity of media sheets remaining in the stack is sufficient to complete the
29 proposed print job. It can be appreciated that the second quantitative measurement and
30 the third quantitative measurement can be the same measurement. That is, a single
31 quantitative measurement can be substituted for both the second quantitative
32 measurement and the third quantitative measurement in the above explanation of the
33 method. Furthermore, it is also understood that the method can be accomplished by an
34 apparatus such as the apparatus 100 that is described above and shown in Fig. 1.

1 In accordance with yet another embodiment of the present invention, a method of
2 dispensing media sheets from a given stack of media sheets includes dispensing a
3 respective plurality of media sheets from each of a plurality of stacks of media sheets. A
4 respective pair of respective quantitative measurements is obtained from each of the
5 plurality of stacks, wherein the respective plurality of media sheets is dispensed between
6 each measurement of the respective pair of quantitative measurements.

7 A respective count is established for each stack, wherein a given count is equal
8 to a respective number of media sheets dispensed between each measurement of the
9 associated pair of quantitative measurements. Furthermore, a respective ratio is
10 established for each stack, wherein a given ratio is equal to the respective count divided
11 by the difference between the respective pair of quantitative measurements.

12 Thus, for each of the plurality of stacks, a pair of quantitative measurements is
13 obtained, and a plurality of media sheets is dispensed from the stack between the pair of
14 measurements, and wherein a respective count is equal to the number of media sheets
15 in the plurality of media sheets. Also, a respective ratio can be associated with each
16 stack, wherein a given ratio is obtained by dividing the associated count by the
17 difference in the pair of quantitative measurements.

18 A target quantitative measurement can be obtained for a given stack, and a mean
19 value of the ratios can be calculated. Also, an estimated quantity of media sheets
20 remaining in the stack can be established by multiplying the mean value of the ratios by
21 the target quantitative measurement. The method can also include providing a proposed
22 print job and evaluating whether the estimated quantity of media sheets remaining in the
23 given stack is sufficient to complete the proposed print job. It is understood that the
24 given stack can be one of the plurality of stacks.

25 It is also understood that each of the stacks can be formed and processed as
26 described above either substantially concurrently, or in succession. That is, the method
27 can be accomplished by way of employing a plurality of apparatus such as the apparatus
28 100 described above and shown in Fig. 1, wherein each of the plurality of stacks is
29 formed and processed in an associated apparatus. Alternatively, the method can be
30 accomplished by employing a single apparatus such as the apparatus 100, wherein the
31 plurality of stacks are formed and processed in succession in the single apparatus.

32 Another method similar to the above-described method can include all of the
33 above-described procedures except that of calculating a mean value of the plurality of
34 ratios. More specifically, rather than calculating a mean value of the plurality of ratios, a
35 similar method can include calculating a median value for the plurality of ratios, with

1 substantially all other procedures being substantially the same as those of the above-
2 described method.

3 That is, in accordance with still another embodiment of the present invention, a
4 method of dispensing media sheets from a given stack of media sheets can include
5 dispensing a respective plurality of media sheets from each of a plurality of stacks of
6 media sheets and obtaining a pair of respective quantitative measurements from each of
7 the plurality of stacks, wherein the respective plurality of media sheets is dispensed
8 between each measurement of the respective pair of quantitative measurements.

9 A respective count is established for each stack, wherein a given count is equal
10 to a respective number of media sheets dispensed between each measurement of the
11 associated pair of quantitative measurements. Furthermore, a respective ratio is
12 established for each stack, wherein a given ratio is equal to the respective count divided
13 by the difference between the respective pair of quantitative measurements.

14 A target quantitative measurement can be obtained for a given stack, and a
15 median value of the ratios can be calculated. An estimated quantity of media sheets
16 remaining in the stack can be established by multiplying the median value of the ratios
17 by the target quantitative measurement. As in the previously discussed similar method,
18 the method at hand can also include providing a proposed print job and evaluating
19 whether the estimated quantity of media sheets remaining in the given stack is sufficient
20 to complete the proposed print job. It is understood that the given stack can be one of
21 the plurality of stacks.

22 While the above invention has been described in language more or less specific
23 as to structural and methodical features, it is to be understood, however, that the
24 invention is not limited to the specific features shown and described, since the means
25 herein disclosed comprise preferred forms of putting the invention into effect. The
26 invention is, therefore, claimed in any of its forms or modifications within the proper
27 scope of the appended claims appropriately interpreted in accordance with the doctrine
28 of equivalents.

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